SGS-THOMSON MICROELECTRONICS

TDA2004A

10 + 10W STEREO AMPLIFIER FOR CAR RADIO

Its main features are :

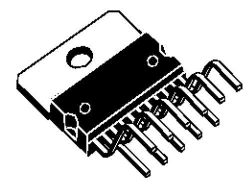
Low distortion.

Low noise.

High reliability of the chip and of the package with additional safety during operation thanks to protections against :

- OUTPUT AC SHORT CIRCUIT TO GROUND
- VERY INDUCTIVE LOADS
- OVERRATING CHIP TEMPERATURE
- LOAD DUMP VOLTAGE SURGE
- FORTUITOUS OPEN GROUND

Space and cost saving : very low number of external components, very simple mounting system with no electrical isolation between the package and the heatsink.



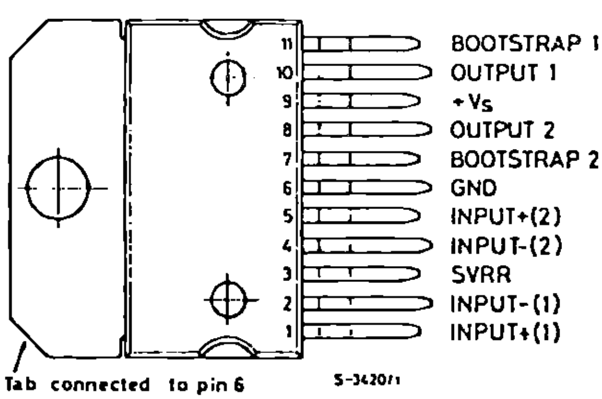
MULTIWATT11

ORDERING NUMBER : TDA2004A

DESCRIPTION

The TDA2004A is a class B dual audio power amplifier in MULTIWATT® package specifically designed for car radio applications ; stereo amplifiers are easily designed using this device that provides a high current capability (up to 3.5 A) and that can drive very low impedance loads (down to 1.6Ω).

PIN CONNECTION (top view)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Opearting Supply Voltage	18	V
V_S	DC Supply Voltage	28	V
V_S	Peak Supply Voltage (for 50ms)	40	V
I_O (*)	Output Peak Current (non repetitive t = 0.1ms)	4.5	A
I_O (*)	Output Peak Current (repetitive f ≥ 10Hz)	3.5	A
P_{tot}	Power Dissipation at T_{case} = 60°C	30	W
T_j, T_{stg}	Storage and Junction Temperature	–40 to 150	°C

(*) The max. output current is internally limited.

THERMAL DATA

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}case}$	Thermal Resistance Junction-case Max.	3	°C/W

ELECTRICAL CHARACTERISTICS (Refer to the test circuit, T_{amb} = 25°C, G_V = 50dB, $Rt_{h\ (heatsink)}$ = 4°C/W, unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_S	Supply Voltage		8		18	V
V_O	Quiescent Output Voltage	VS = 14.4V V_S = 13.2V	6.6 6.0	7.2 6.6	7.8 7.2	V V
I_d	Total Quiescent Drain Current	V_S = 14.4V V_S = 13.2V		65 62	120 120	mA mA
I_{SB}	Stand-by Current	Pin 3 grounded		5		mA
P_O	Output Power (each channel)	f = 1KHz, d = 10% V_S = 14.4V R_L = 4Ω R_L = 3.2Ω R_L = 2Ω R_L= 1.6Ω V_S = 13.2V R_L = 3.2Ω R_L= 1.6Ω V_S = 16V; R_L = 2Ω	 6 7 9 10 6 9 	 6.5 8 10(*) 11 6.5 10 12		 W W W W w w w
d	Distortion (each channel)	f = 1KHz V_S = 14.4V; R_L = 4Ω P_O = 50mW to 4W V_S = 14.4V; R_L = 2Ω P_O = 50mW to 6W V_S = 13.2V; R_L = 3.2Ω P_O = 50mW to 3W V_S = 13.2V; R_L = 1.6Ω P_O = 50mW to 6W		 0.2 0.3 0.2 0.3	 1 1 1 1	 % % % %
CT	Cross Talk	V_S = 14.4V V_O = 4Vrms R_L = 4Ω f = 1KHz f = 10KHz R_g = 5KΩ	 50 40	 60 45		 dB dB
V_i	Input Saturation Voltage		300			mV

ELECTRICAL CHARACTERISTICS (continued

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
R_i	Input Resistance (non inverting input)	f = 1KHz	70	200		KΩ
f_L	Low Frequency Roll off (-3dB)	R_L = 4Ω R_L = 2Ω R_L = 3.2Ω R_L= 1.6Ω			35 50 40 55	Hz Hz Hz Hz
f_H	High Frequency Roll off (-3dB)	R_L = 1.6Ω to 4Ω	15			KHz
G_V	Voltage gain (open loop)	f = 1KHz		90		dB
	Voltage gain (closed loop)	f = 1KHz	48	50	51	dB
	closed loop gain matching			0.5		dB
e_N	Total Input noise Voltage	R_g = 10KΩ (**)		1.5	5	μV
SVR	Supply Voltage Rejection	f_{ripple} = 100Hz; R_g = 10KΩ C3 = 10μF V_{ripple} = 0.5Vrms	35	45		dB
η	Efficiency	V_S = 14.4V f = 1KHz R_L = 4Ω P_O = 6.5W R_L = 2Ω P_O = 10W V_S = 13.2V f = 1KHZ R_L = 3.2Ω P_O = 6.5W R_L = 1.6Ω P_O = 10W		 70 60 70 60		 % % % %
T_J	Thermal Shutdown Junction Temperature			145		°C

Notes : (*) 9.3W without Bootstrap
(**) Bandwith Filter : 22Hz to 22KHz.

Figure 1 : Test and Application Circuit.

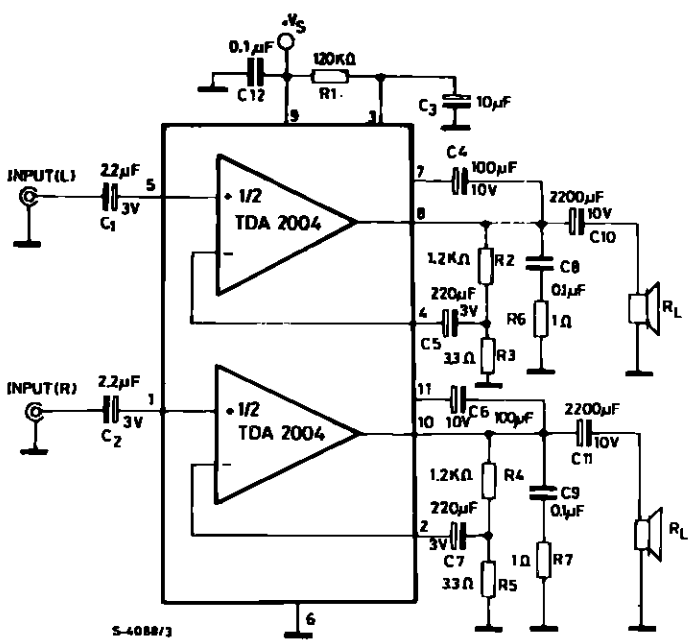


Figure 2 : P.C. Board and Component layout of the fig. 1 (scale 1 : 1).

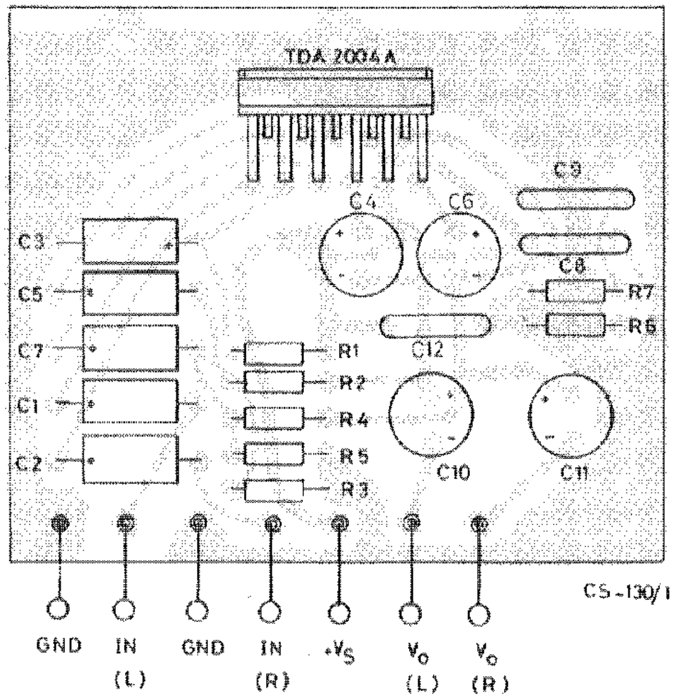


Figure 3 : Quiescent Output Voltage vs. Supply Voltage.

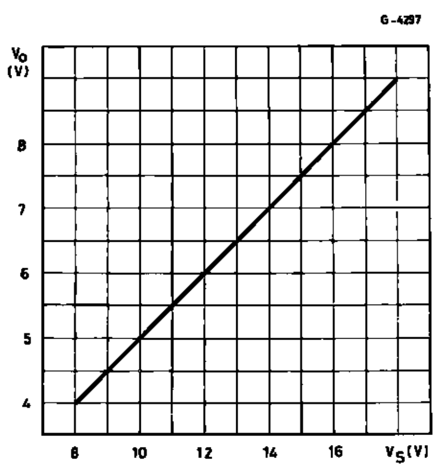


Figure 4 : Quiescent Drain Current vs. Supply Voltage.

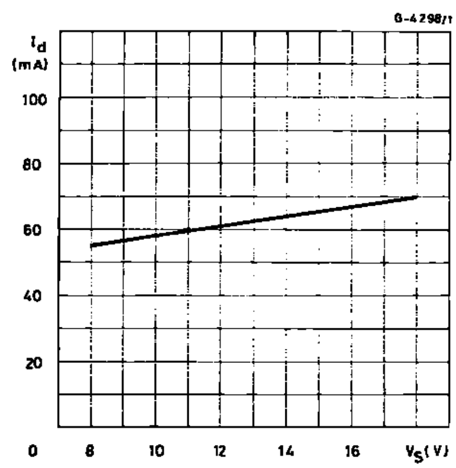


Figure 5 : Distortion vs. Output Power.

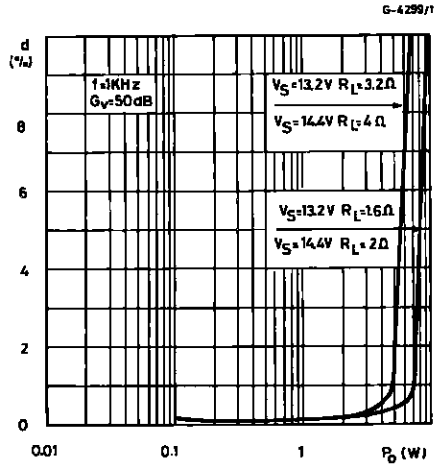


Figure 6 : Output Power vs. Supply Voltage.

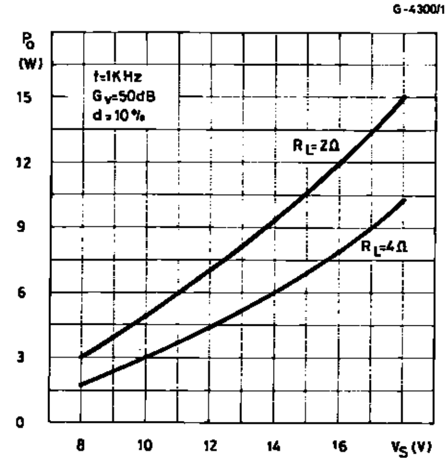


Figure 7 : Output Power vs. Supply Voltage.

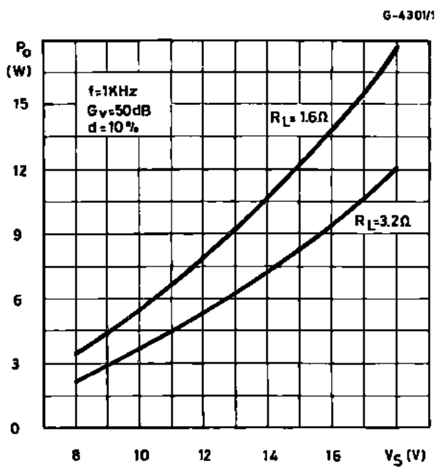


Figure 8 : Distortion vs. Frequency.

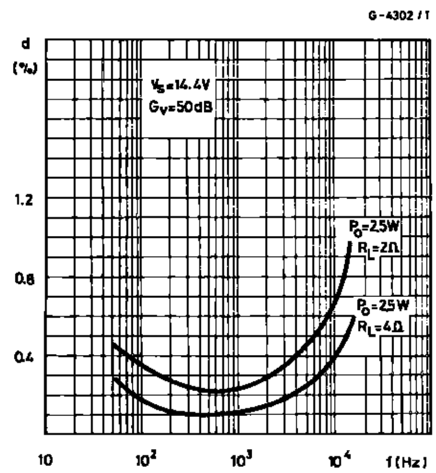


Figure 9 : Distortion vs. Frequency.

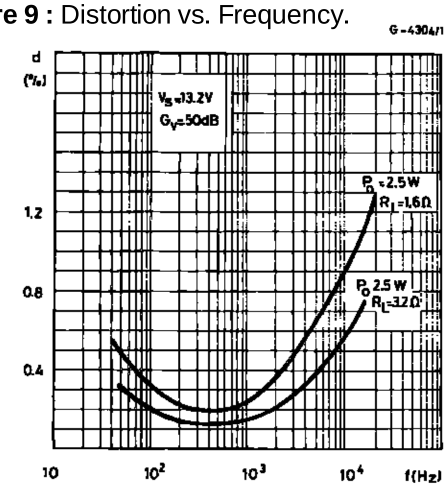


Figure 10 : Supply Voltage Rejection vs. C_3.

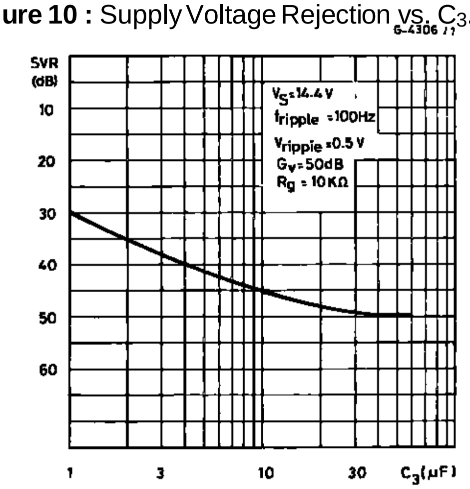


Figure 11 : Supply Voltage Rejection vs. Frequency.

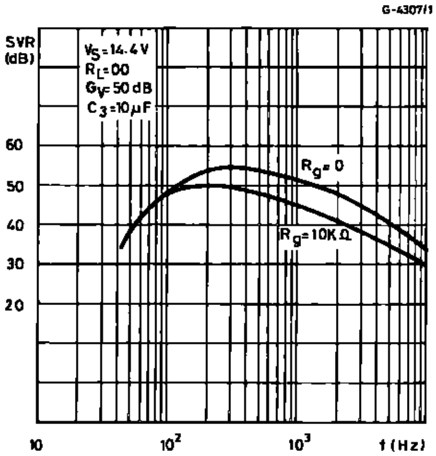


Figure 12 : Supply Voltage Rejection vs. Values of Capacitors C_2 and C_3.

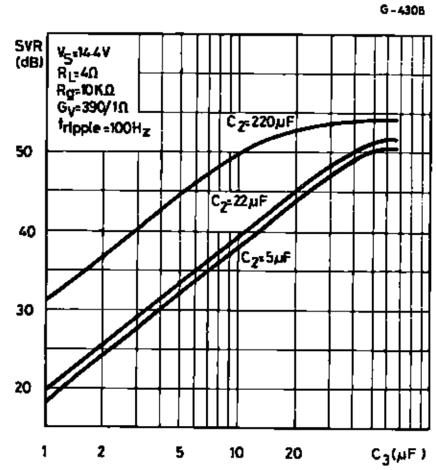


Figure 13 : Supply Voltage Rejection vs. Values of Capacitors C_2 and C_3.

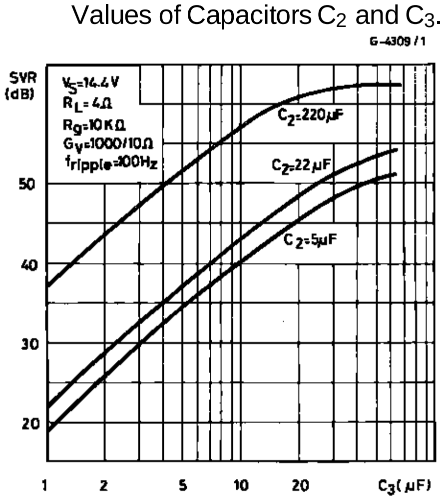


Figure 14 : Gain vs. Input Sensitivity.

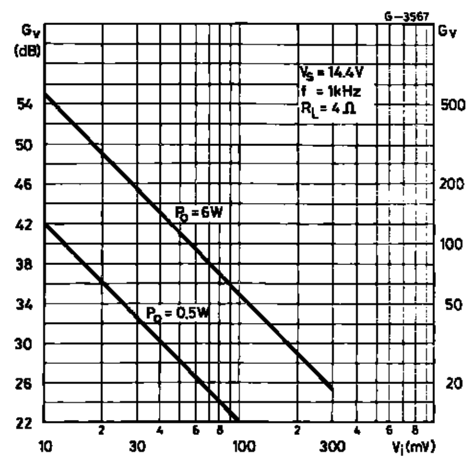


Figure 15 : Maximum Allowable Power Dissipation vs. Ambient Temperature.

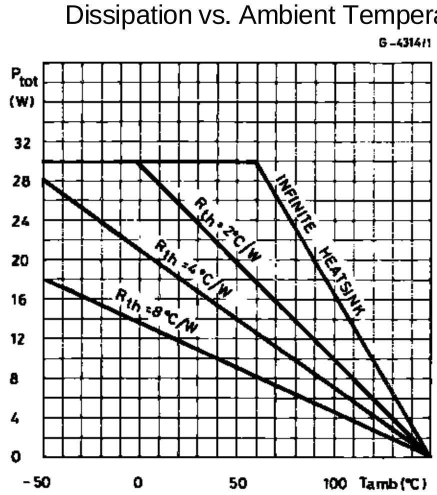


Figure 16 : Total Power Dissipation and Efficiency vs. Output Power.

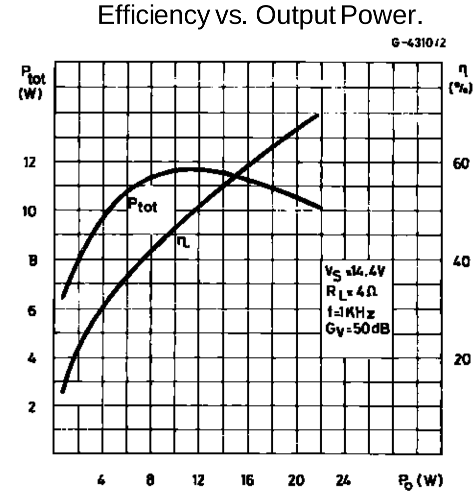
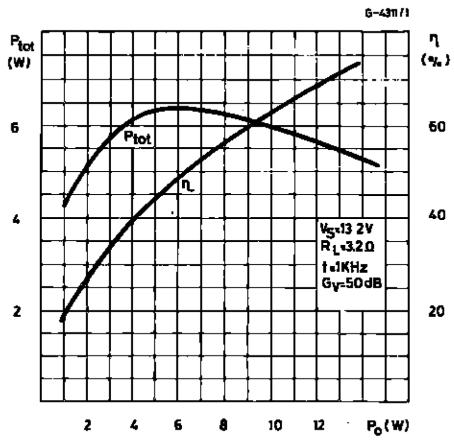


Figure 17 : Total Power Dissipation and Efficiency vs. Output Power .



APPLICATION SUGGESTION

The recommended values of the components are those shown on application circuit of fig.1. Different values can be used ; the following table can help the designer.

Component	Recomm. Value	Purpose	Larger Than	Smaller Than
R1	120KΩ	Optimization of the output signal simmetry	Smaller P_O max.	Smaller P_O max.
R2, R4	1KΩ	Close loop gain setting (*)	Increase of gain	Decrease of gain
R3, R5	3.3Ω		Decrease of gain	Increase of gain
R6, R7	1Ω	Frequency stability	Danger of oscillation at high frequency with inductive load	
C1, C2	2.2µF	Input DC decoupling	High turn-on delay	High turn-on pop Higher low frequency cutoff. Increase of noise
C3	10µF	Ripple Rejection	Increase of SVR. Increase of the switch-on time.	Degradation of SVR.
C4, C6	100µF	Boostrapping		Increase of distortion at low frequency
C5, C7	100µF	Feedback Input DC decoupling.		
C8, C9	0.1µF	Frequency Stability		Danger of oscillation.
C10, C11	1000µF to 2200µF	Output DC decoupling.		Higher low-frequency cut-off.

(*) The closed–loop gain must be higher than 26dB.

BUILT–IN PROTECTION SYSTEMS

LOAD DUMP VOLTAGE SURGE

The TDA2004A has a circuit which enables it to withstand a voltage pulse train, on pin 9, of the type shown in Fig. 19.

If the supply voltage peaks to more than 40 V, then an LC filter must be inserted between the supply and pin 9, in order to assure that the pulses at pin 9 will be held within the limits shown.

A suggested LC network is shown in Fig. 18. With this network, a train of pulse with amplitude up to 120 V and with of 2 ms can be applied to point A. This type of protection is ON when the supply voltage (pulse or DC) exceeds 18 V. For this reason the maximum operating supply voltage is 18 V.

Figure 18.

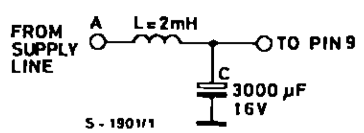
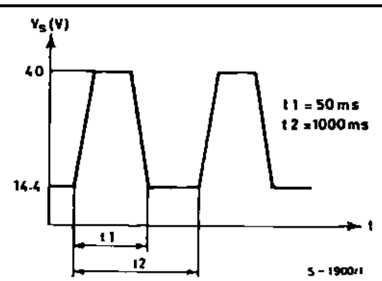


Figure 19.



SHORT CIRCUIT (AC conditions)

The TDA2004A can withstand an accidental short-circuit from the output to ground caused by a wrong connection during normal working.

POLARITY INVERSION

High current (up to 10 A) can be handled by the device with no damage for a longer period than the blow-out time of a quick 2 A fuse (normally connected in series with the supply). This feature is added to avoid destruction, if during fitting to the car, a mistake on the connection of the supply is made.

OPEN GROUND

When the ratio is the ON condition and the ground is accidentally opened, a standard audio amplifier will be damaged. On the TDA2004A protection diodes are included to avoid any damage.

INDUCTIVE LOAD

A protection diode is provided to allow use of the TDA2004A with inductive loads.

DC VOLTAGE

The maximum operating DC voltage on the TDA2004A is 18 V.

However the device can withstand a DC voltage up to 28 V with no damage. This could occur during winter if two batteries are series connected to crank the engine.

THERMAL SHUT-DOWN

The presence of a thermal limiting circuit offers the following advantages :

1) an overload on the output (even if it is permanent), or an excessive ambient temperature can be easily withstood.

2) the heatsink can have a smaller factor of safety compared with that of a conventional circuit. There is no device damage in the case of excessive junction temperature ; all that happens is the P_O (and therefore P_{tot}) and I_d are reduced.

The maximum allowable power dissipation depends upon the size of the external heatsink (i.e. its thermal resistance) ; fig. 15 shown this dissipable power as a function of ambient temperature for different thermal resistance.

MULTIWATT11 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			5			0.197
B			2.65			0.104
C			1.6			0.063
D		1			0.039	
E	0.49		0.55	0.019		0.022
F	0.88		0.95	0.035		0.037
G	1.45	1.7	1.95	0.057	0.067	0.077
G1	16.75	17	17.25	0.659	0.669	0.679
H1	19.6			0.772		
H2			20.2			0.795
L	21.9	22.2	22.5	0.862	0.874	0.886
L1	21.7	22.1	22.5	0.854	0.87	0.886
L2	17.4		18.1	0.685		0.713
L3	17.25	17.5	17.75	0.679	0.689	0.699
L4	10.3	10.7	10.9	0.406	0.421	0.429
L7	2.65		2.9	0.104		0.114
M	4.25	4.55	4.85	0.167	0.179	0.191
M1	4.73	5.08	5.43	0.186	0.200	0.214
S	1.9		2.6	0.075		0.102
S1	1.9		2.6	0.075		0.102
Dia1	3.65		3.85	0.144		0.152

